

THE SCIENTIFIC REVOLUTION

GEOCENTRIC V. HELIOCENTRIC

- Geocentric: Aristotle, Ptolemy and the Catholic church
- Heliocentric: Copernicus
 - *On the Revolution of Heavenly Bodies...*
 - first new view of the universe in 2000 years



TYCHO BRAHE AND JOHANNES KEPLER

- **Brahe** spent 20 years studying the motion of planets and stars
- **Kepler** used Brahe's data to formulate 3 laws of planetary motion
 - 1. planets revolve around the sun in elliptical orbits
 - 2. planets move more rapidly as their orbits approach the sun
 - 3. time taken to orbit the sun varies proportionally with their distance from the sun

GALILEO GALLILEI

- 1564-1642
- Law of the pendulum
- Falling objects accelerate at a fixed and predictable rate
- telescope



STARRY MESSENGER

- Jupiter had four moons
- The sun had dark spots
- The moon had a rough, uneven surface

● HELIOCENTRIC THEORY

- THE SAME PHYSICAL LAWS OPERATED THROUGHOUT THE UNIVERSE

GALILEO'S CONFLICT WITH THE CHURCH

- 1616: Church banned Copernicus's theory
- 1632: Dialogue on the Two Chief World Systems
- 1633: Galileo on trial. Condemned and placed under house arrest.
- 1992: Catholic church admitted that they had erred.

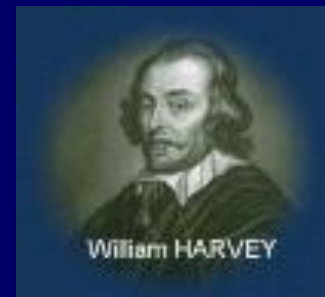


ADVANCES IN HUMAN PHYSIOLOGY



□ Versalius: On the Fabric of the Human Body

□ Harvey: heart is a pump



SCIENTIFIC TOOLS

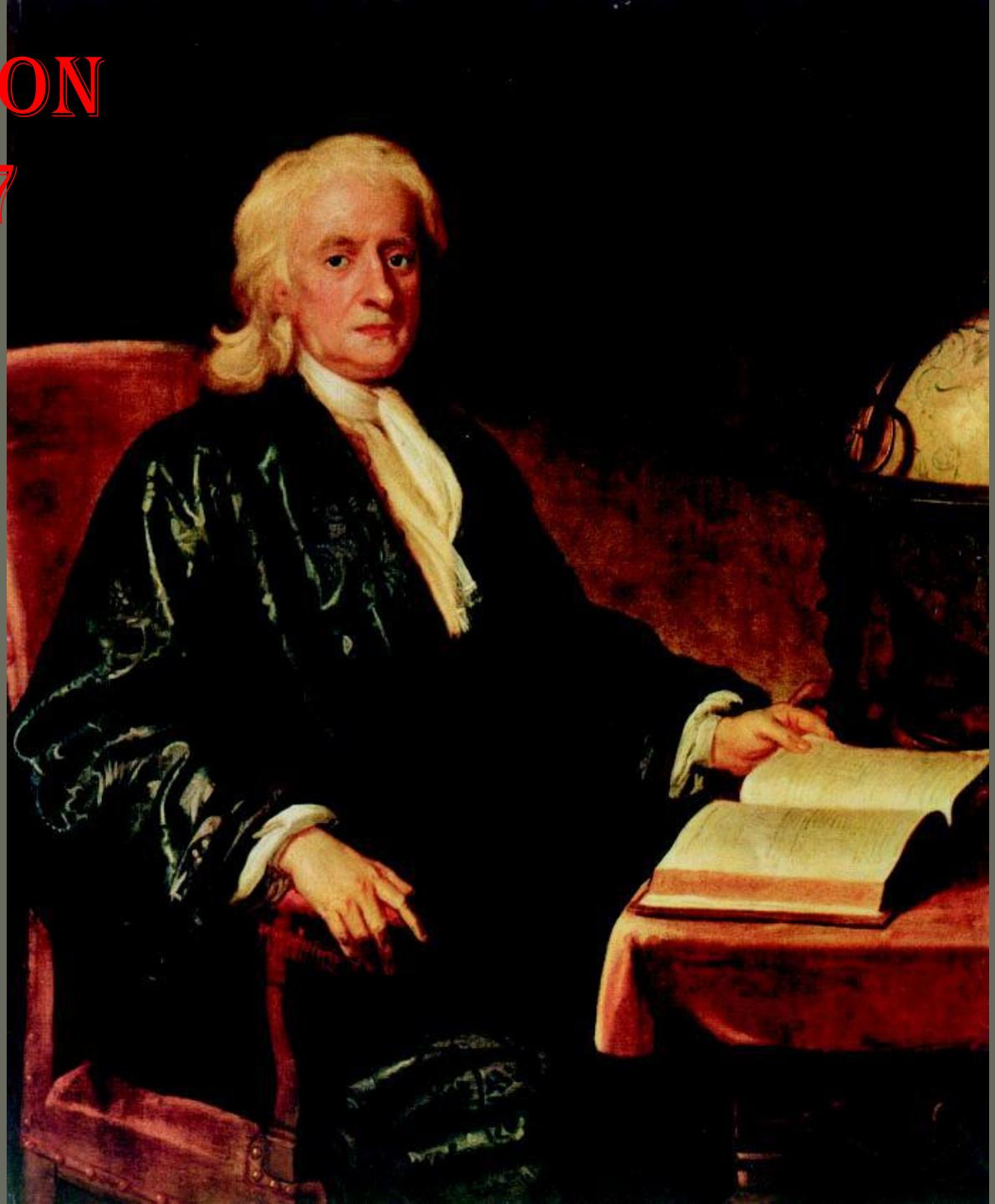
Microscope: invented by Zacharias Janssen 1590
Used by van Leeuwenhoek to observe bacteria
and red blood cells

Thermometer: Galileo: 1603...alcohol
Fahrenheit:...mercury 32 to 212
Celsius...mercury 0 to 100

Barometer: Torricelli...to measure atmospheric
pressure 1655

ISAAC NEWTON

1642-1727



PRINCIPIA MATHEMATICA

- Addressed the issue of planetary motion
- Established the basis for physics
- Attraction of gravity explained why planets moved in an orderly rather than chaotic manner

LAW OF UNIVERSAL GRAVITATION

- “the force of gravity toward the whole planet did arise from and was compounded of the forces of gravity towards all its parts, and towards every one part was in the inverse proportion of the squares of the distances from the part.”

NEWTON'S LAWS

- An object moving in a straight line will continue moving in a straight line unless acted on by an outside force. An object at rest stays at rest. (inertia)
- $F=ma$ (force = mass x acceleration) Force will cause a change in the motion of an object.
- For each action, there is an equal and opposite reaction.

NEWTON'S BELIEFS...

- ...religion and science were compatible
- ...the study of nature gave one a better understanding of the Creator
- ...the importance of empirical data and observation

...THE IDEA OF MECHANISM...

- ◆ Explaining the world in terms of mechanical metaphors...the language of machinery
- ◆ Nature conceived as machinery took the divine out of the picture

DEISM

- God as a divine watchmaker who arranged the world as a machine that would function automatically...
- World was turned over to God's greatest creation, man...
- The language of science and natural philosophy became that of mathematics...

FRANCIS BACON

1561-1626



- Set an intellectual tone
- Created a climate conducive to scientific work
- Attacked scholastic belief
- *Father of empiricism* and experimentation in science
- Championed the desirability of innovation and change
- Used the *inductive method* to gain knowledge

DESCARTES

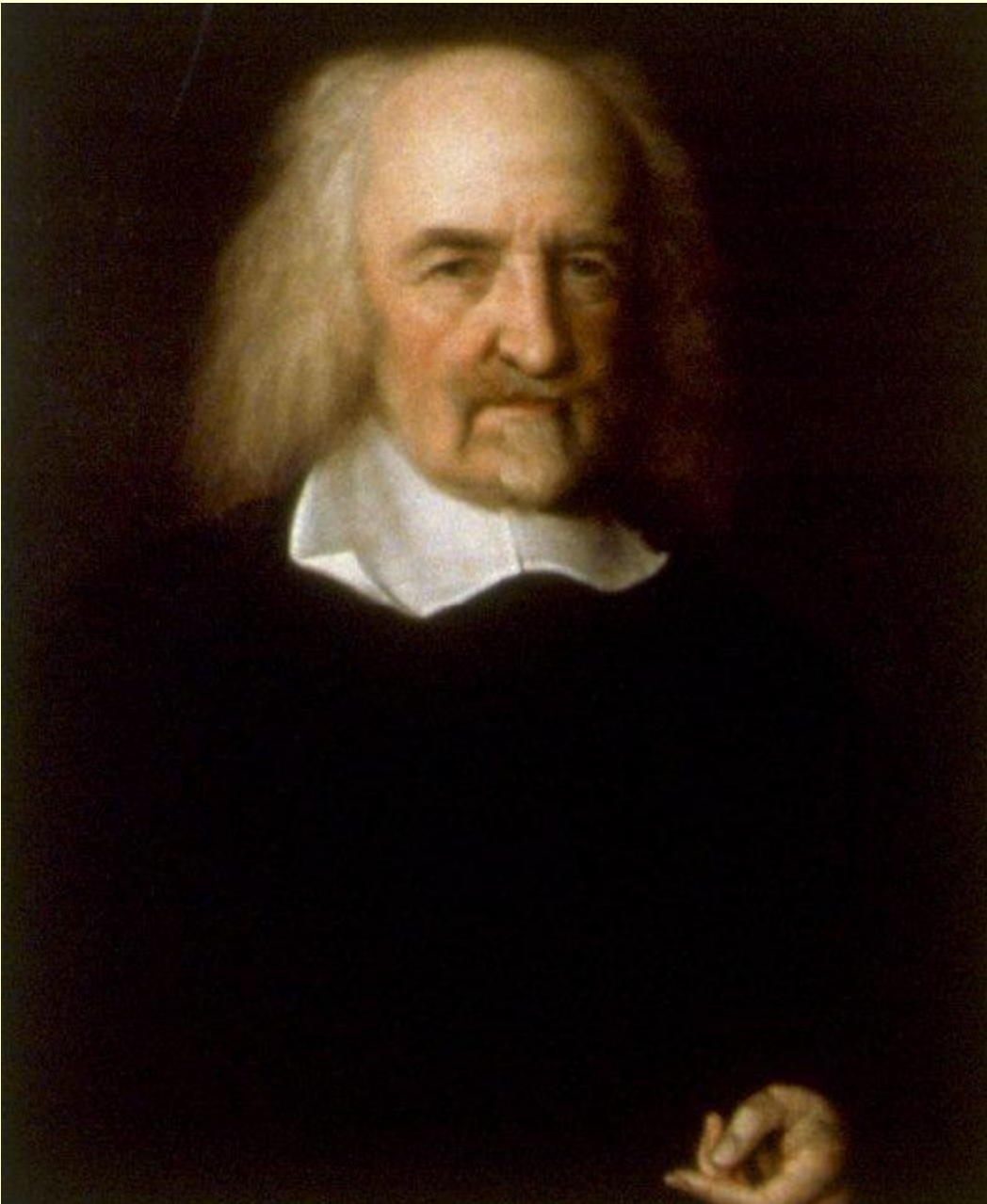
1596-1650



“Cogito, ergo sum.”

- Invented analytic geometry
- Deduction, rational speculation, internal reflection
- ...doubt everything except that about which he could have clear and distinct ideas...
- Deduced the existence of God





THOMAS
HOBBS
1588-1679

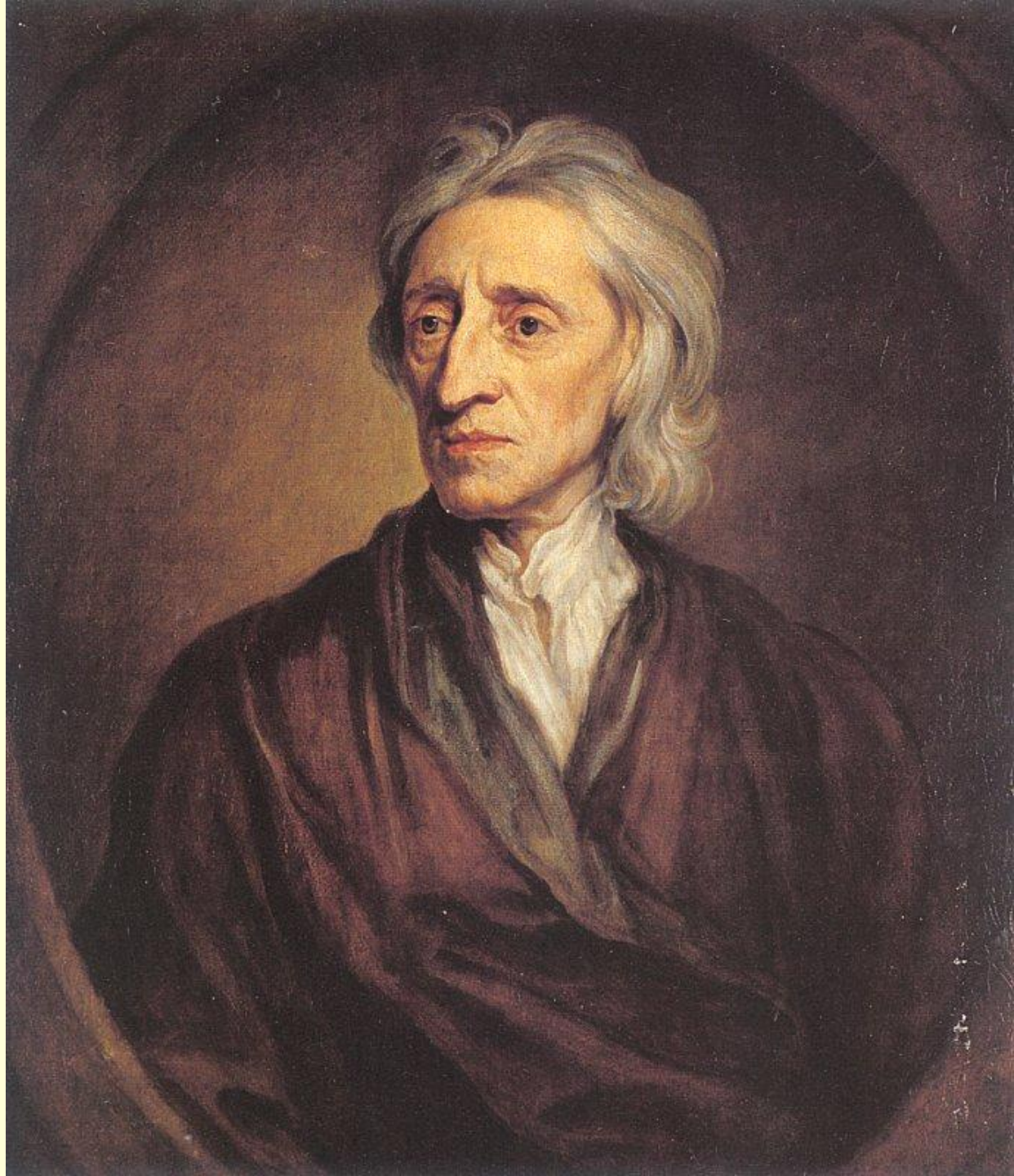
LEVIATHAN





- Portrayed rulers as absolute lords over their lands...
- Humans were self-centered creatures...
- Original human condition: a state of inevitable conflict where neither safety, security or any final authority existed...
- Absolute authority could be lodged in either a monarch or a legislative body...
- Obedience to that authority had to be absolute to assure order...

JOHN LOCKE
1634-1704



CRITIC OF ABSOLUTISM...

- Foundation of later liberal political philosophy
 - *Two Treatises of Government*
 - *Letter Concerning Toleration*
- Early writings in psychology
 - *Essay Concerning Human Understanding*
- Locke felt that men in their natural state were creatures of reason and basic goodwill.

TREATISES ON GOVERNMENT

- Natural state one of freedom and equality
- Rights of life, liberty and property
- Men enter into a contract to form a political society to preserve those rights
- Government exists to protect those rights
- Relationship between the rulers and the governed is that of trust
- If rulers betray that trust, the governed have the right to replace them....

...JUSTIFICATION OF
THE GLORIOUS
REVOLUTION OF 1688...

ESSAY CONCERNING HUMAN UNDERSTANDING

- mind at birth is a “tabula rasa”
- the human condition could be improved by changing the environment...**nurture**
- reason and revelation were compatible
- moderate religious faith could avoid religious conflict

NEW KNOWLEDGE NEEDED NEW INSTITUTIONS...

- Royal Society of London 1660
 - Academy of Experiements in Florence 1657
 - French Academy of Science 1667
 - Berlin Academy of Science 1700
-
- Presented science as an enterprise to aid the government and economy
 - Interaction of individual work, publications and societies



WOMEN IN THE SCIENTIFIC REVOLUTION

- European intellectual life mostly excluded women
- Women not admitted to scientific societies
- Rare exceptions....

MARGARET CAVENDISH



- 1623-1673
- Only 17th century woman to attend meeting of Royal Society
- Made contributions to scientific literature
- Quarreled with ideas of Descartes and Hobbes

MARIA WINKELMANN

- Teamed with husband Gottfried Kirch
- Astronomy team
- Discovered comet...attributed to her husband until 1930
- Applied to be astronomer at Berlin Academy after her husband's death...rejected due to gender
- *No pictures of Maria were available on a Google search*

Emilie du Chatelet and Voltaire...

1730's

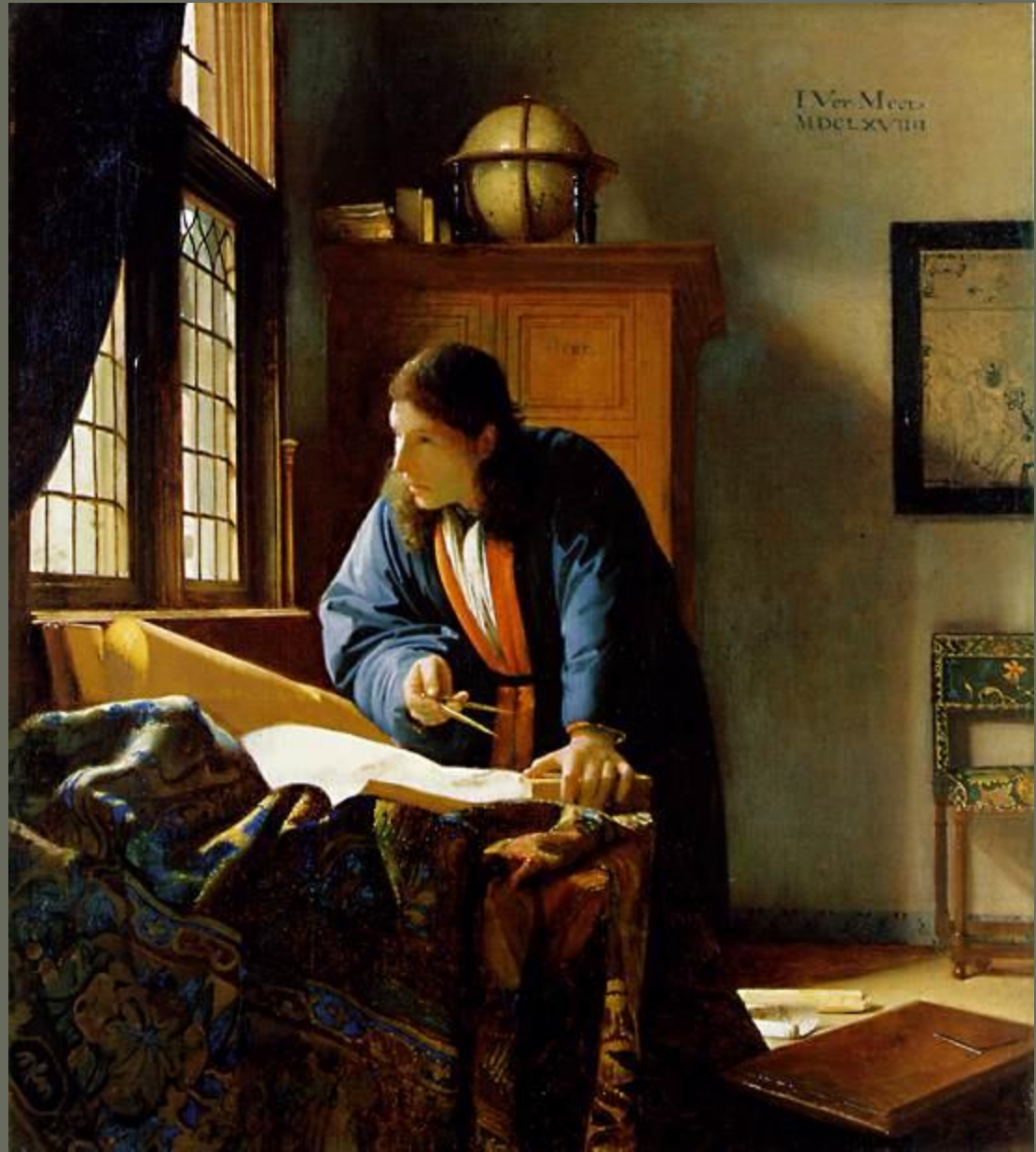


- Aided Voltaire in his popularization of Newtonian science in French
- Her math skills made it possible for him to complete the book

- ...but it was a fundamental assumption of European intellectual life that the pursuit of natural philosophy...science...was only for the male gender!!!...
- ...institutions of science and its disciplines, including medicine, philosophy and biology, viewed the female mind as different from and inferior to the male...

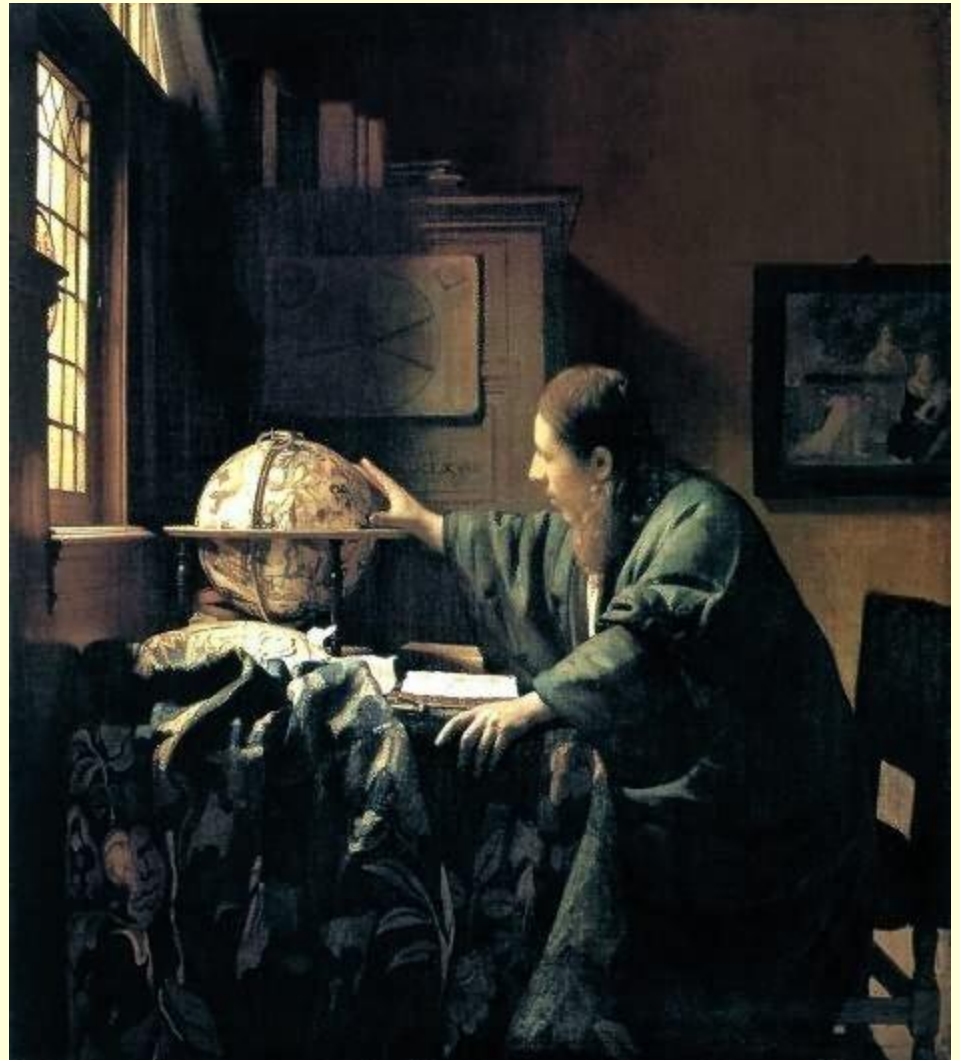
VERMEER

● The Geographer



VERMEER

- *The Astronomer*



NEW SCIENCE AND RELIGIOUS FAITH

- 1. Certain theories and discoveries did not agree with the Bible.
- 2. Who decides when there is a conflict between religion and science??
- 3. New science offered only a materialistic universe, not a spiritual one.
- *THE RECONCILIATION OF FAITH AND REASON ENABLED THE NEW SCIENCE TO SPREAD THROUGHOUT EUROPE*

BLAISE PASCAL

1623-1662



- French mathematician and physical scientist
- *Pensées*...faith and reason
- 2 essential truths
 - a loving God exists
 - men, corrupt by nature, are utterly unworthy of God
- Convinced that belief in God improved life psychologically and disciplined it morally

...the English approach to science and reason...

- “Faith in a rational God encouraged faith in the rationality of human beings and in their capacity to improve their lot once liberated from the traditions of the past.”
- The Scientific Revolution provided the great model for the desirability of change and of criticism of inherited views.
- ...associated in the public mind with consumption and the market economy...
- *CHANGE AND IMPROVEMENT...*

SUPERSTITION AND WITCHHUNTS

